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# COMING TO TERMS WITH SNOMED CT® TERMS: LINGUISTIC AND TERMINOLOGICAL ISSUES RELATED TO THE TRANSLATION INTO DANISH

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## INTRODUCTION

For many years, the Danish medical terminology, as represented in text books, articles, encyclopedia, dictionaries, and classifications, has been marked by discrepancies regarding the choice of terms and morphological and syntactical features. The growing use of electronic aids and information technologies has brought about a recognition of the need for terminological consensus as far as general, commonly used medical concepts are concerned.

This recognition led to two important initiatives at the beginning of the present century:

- the establishment of a National Health Terminology Committee (Det Nationale Begrebsråd) whose main task consists in defining a number of top-level concepts within areas such as administration, medication, and quality management, and
- the launching of the SUNDTERM Project the aim of which is to establish a common health terminology which may be used for the Basic Structure for Electronic Health Records (GEPJ) and which allows for mapping of terms and concepts to existing classifications in Danish like the national versions of ICD, ICF, ICPC, nursing diagnoses, etc. (The Ministry of the Interior and Health, 2003).

The translation of Systematized Nomenclature of Medicine Clinical Terms, SNOMED CT®, into Danish, carried out by the Danish National Board of Health (SST), forms part of the SUNDTERM Project. This article describes and discusses the bases and principles on which the huge SUNDTERM translation task is based as well as some important issues and problems which have arisen in connection with the translation of – so far – almost 150,000 medical terms.

The author of the article has been involved in the SST project as a language and terminology consultant since October 2003.

## SNOMED CT® – A MULTIHIERARCHICAL TERMINOLOGY

This vast terminology system was created by combining SNOMED Reference Terminology (SNOMED RT) and Clinical Terms Version 3 (CTV3), formerly known as the Read Codes, which was created on behalf of U.K. Department of Health and is a Crown copyright. SNOMED CT®, first released in January 2003, is a registered trademark of the College of American Pathologists (CAP). It comprises 350,000 concepts represented by some 1,000,000 terms, i.e. "preferred terms" and synonyms. As explained by Spackman and Reynoso (Spackman et al. 2004), it is "a terminological resource designed to be implemented in software applications to represent clinically relevant information reliably and reproducibly" (further information concerning the history of SNOMED CT® may be found in the introductory sections of their article). SNOMED CT® is an ontology-like terminology organized in a number of generic (IS-A) hierarchies, each of which covers a semantic field like Finding, Procedure, Body Structure, Substance, Infective Agent, etc. Terms representing concepts related to non-medical information needed for patients' health records are included, too – they may be found in hierarchies like Environment and Geographical location, Event, or Physical object. Each concept is linked to one or more concepts in other hierarchies by means of semantic relations, and a concept may have more than one parent concept (IS-A relation).

The semantic relations make up a structured definition of the SNOMED concept – as opposed to a textual definition: each defining or qualifying characteristic of the concept is represented by a relation composed of an attribute + a value. Thanks to the impressive number of concepts and the possibility of combining concepts, SNOMED CT® contains the vast majority of the terms and concepts needed for the recording of fundamental information in patients' health records.

Thus, two concepts like *transhepatic portogram* (belonging to the Procedure hierarchy) and *drug-induced dermatosis* (belonging to the Finding hierarchy)1 have several relations: they both have more than one parent concept (IS-A relations) and both point to a concept in the Body Structure hierarchy by means of a semantic relation composed of the attribute SITE + a value chosen among the Body Structure concepts. As for transhepatic portogram, the method used to obtain the portogram is described by pointing to another concept belonging to the Procedure hierarchy: imaging; and particular characteristics of the concept are described by means of two relations: the approach used and the intent of the procedure. Drug-induced dermatosis has two other relations – one reflecting the fact that the condition manifests itself in a change of the structure of a body tissue, and one reflecting the cause of the condition:

*1. transhepatic portogram*
IS-A abdominal angiografi
IS-A venography
IS-A procedure by approach
APPROACH transhepatic approach
METHOD imaging
HAS INTENT diagnostic
PROCEDURE SITE portal vein structure

*2. drug-induced dermatosis*
IS-A skin lesion
IS-A drug-induced lesion
ASSOCIATED MORPHOLOGY morphologically abnormal structure
CAUSATIVE AGENT pharmaceutical/biological product
FINDING SITE skin structure.

The corresponding textual definitions of these two concepts could be:
*1. abdominal angiography imaging of the portal vein for diagnostic purposes performed by means of transhepatic approach*
*2. skin lesion resulting in morphological alterations and caused by a pharmaceutical or biological product.*

In the case of complex concepts involving for instance several conditions of different aethiological origins, a principle known as role grouping is applied to the pattern of the semantic relations between the hierarchical concepts involved (Spackman et al. 2002). Explaining the principles of role grouping would exceed the scope of this article; what should be stressed, however, is that role grouping provides an extremely useful source of information for all project participants in cases where a term may be interpreted in several ways.

The fact that concepts are defined by certain relations and inter-linked in a highly structured way means that once the terminology has been implemented and coordinated with the GEPJ system, it will be possible to extract selected data from a large number of health records for statistic, economic, or even diagnostic purposes. Relations may be patterns for extraction of relevant information associated with a certain concept. It would, for instance, be possible to find out how many patients in region X had their appendix removed in year Y by method Z by setting specific search criteria for the different information categories contained in the health records. Or it would be possible to find out which one of several medication regimes was, within a given period of time, the most successful as a cure against pneumonia caused by a specific bacteria.

## Remarks concerning ontological and epistemological issues

When faced with SNOMED CT® terms in a translation context, it is useful to bear in mind that the terminology is not 100% consistent and that errors or inconsistencies do occur on the word as well as the

system level: although SNOMED CT® may be regarded as a domain ontology, it does not always meet formal ontological requirements. This problem has been pointed out by several researchers dealing with medical informatics and SNOMED CT® modeling (Spackman et al. 2002 & 2004, Bodenreider et al. 2004), and it is one of the issues which need to be dealt with by the coming SNOMED Standards Development Organisation, SDO. (For information on the foundation and organisation of this international organisation, consult http://www.hiww.org/smcs2006/programme.html.)

Indeed, some SNOMED CT® terms represent concepts whose place in the hierarchy is the result of classifications of concepts based on conventions, presumptions or habits rather than on scientific laws. An illustrative example, mentioned by Bodenreider et al (Bodenreider et al. 2004)) in their article on the "ontology-epistemology divide", is Gram negative bacteria versus Gram positive bacteria which have been named, not after some intrinsic characteristics, but after extrinsic characteristics, i.e. according to their reaction when exposed to crystal violet dye. Similar examples of concepts violating true ontological principles are phantom limb syndrome without pain, in which the specification without pain does not indicate a reality of the phantom limb itself, but has been added in order to indicate that the normal presumption, i.e. that the phantom limb syndrome is accompanied by pain, does not apply in this case. And in the case of possible thrombus, which is, in the ontological sense, a non-existing entity, the modifier refers implicitely to the criteria on which a diagnosis of thrombus would be based.

As long as the classification principles or the epistemological background are universal, equivalence may be expected between concepts in English and Danish. Indeed, in most cases, the ontology-epistemology issue does not represent a problem to the translation as such. However, misplacement of concepts does occur and may complicate the translation. For example, the concept fairly heavy drinker (Finding) can be found in the sub-hierarchy Finding relating to alcohol drinking behavior (Finding). If one considers the semantics of the term fairly heavy drinker, it becomes clear that the principle of top-to-bottom IS-A relations has been violated: the English term ought to have been fairly heavy drinking habits (Finding). In cases like this one, there is no doubt that the translation should respect the principle of concept based translation rather than term based translation. However, in less evident cases, where the actual meaning of the term cannot be detected by consulting the concept relation patterns, the general principle adopted within the SUNDTERM project has been to respect the English term while making a note of the problem. Corrections and improvements of the structure of the SNOMED terminology will be a continuous process, and the Danish terminology will have to be updated accordingly.

## GETTING THE SUNDTERM PROJECT STARTED

### Basic principles

The basic approach of the translation project is pragmatic-functionalist: the aim of the project, i.e. establishing a terminology functioning as a background system for the electronic health record is constantly kept in mind, and an effort is made to provide terms which reflect the underlying concepts and are understandable and psychologically acceptable to the clinician.

The overall approach has been one of close collaboration between specialists within medicine and/or informatics, and linguists/terminologists. As pointed out by numerous professionals and terminologists, interdisciplinary collaboration is crucial in terminology work (Infoterm 2005). On the one hand, a translation based solely on linguistic, morphological- syntactical analysis might result in a seemingly correct term which would not after all represent the concept in question, or which would not be used by professionals. On the other hand, for pedagogical (and normative) reasons, a certain compliance with linguistic, systematic, and orthographic principles is necessary in order to avoid confusion and ensure practical applicability of the terminology. In practice, this means that a set of basic principles to secure consistency are followed, but in case of serious conflicts with daily clinical language the clinical use prevails.

### Initial studies and organisation

During 2003, the Danish National Board of Health (SST) carried out a series of studies of SNOMED CT®. Eventually, it was deemed applicable as a basis for the above mentioned GEPJ, which is developed in

preparation for exchange of clinical information in Denmark. A trial translation of about 40,000 terms, followed by clinical testing, was carried out during 2004, and in the spring of 2005, the SUNDTERM Project as such was adopted and launched.

The SUNDTERM translation project has been divided into two phases. Phase I comprises translation of the terms representing the concepts and initial approval of terms in order to ensure that the terms are understandable and possibly also acceptable to the clinicians. Phase II, which has been initiated in 2006, consists in reviews by clinicians, including the addition of synonyms as well as clinical testing of the terminology.

Contracts were signed with a translation bureau (Intertext), work flows were defined, and a web-based IT system to support work flow processes was developed by a software company (CareCom A/S). All specialists involved in the translation process participated in a seminar in which the SNOMED CT® structure as well as the aims, principles, methods, translation tools, work flows, timetables, etc. of the project, were presented and debated.

An Editorial Board consisting of about 10 persons was formed; apart from an advisory and quality management function, the main tasks of the Editorial Board comprise the updating of documents containing linguistic/terminological guidelines for the translators and the SST reviewers as well as suggesting solutions for particular translation problems. The board is composed of medical doctors and other health professionals, some of whom have a masters' degree in health informatics, as well as professionals with an educational background in LSP (Language for Specific Purposes) translation, linguistics, and terminology. The Editorial Board meets at regular intervals; the majority of its members are SST employees some are consultants and two represent the translation bureau.

During its first six months of Phase I, the Editorial Board carried out discussions with various specialists in order to refine and revise the general guidelines and to ensure its awareness of current tendencies regarding e.g. information search techniques and computational linguistic strategies, as well as of principles applied in other projects involving medical terminology. These meetings included a presentation of term extraction tools by ass. prof. Lotte Weilgaard from the University of Southern Denmark, consultations with prof. Bodil Nistrup Madsen, DANTERMcentret and Copenhagen Business School, terminology consultant of the National Health Terminology Committee, and discussions regarding syntax and morphology with MD, lic.scient. Søren Nørby, editor of the latest edition of the Danish cyclopedic medical dictionary (Klinisk ordbog), and Jørgen Schack, researcher at the Danish Language Council.

### Organising the translation process

A special web-application with restricted access was elaborated by the Danish software company CareCom A/S. The basic ideas behind the application were that

- all participants were to work on a common web-based platform
- each concept was to pass through a work flow – from translation via review to approval
- all authorized users should have access to all information needed about each concept as well as to various sources provided by the SST (i.e. general guidelines and translation suggestions provided by the Editorial Board, a number of textbooks in electronic form, and useful references of high validity).

The people involved in the SUNDTERM translation process, i.e. translators, SST staff, and consultants, were assigned log-ins and access authority according to their role in the translation process: translators may translate only, not validate the terms, and reviewers cannot change suggested translation, but must either accept the term or send it to the Editorial Board with a remark/question/suggested change. In this way the Editorial Board functions as the ultimate instance of review.

## GUIDELINES AND IMPORTANT ISSUES REGARDING THE TRANSLATION OF SNOMED CT®

As mentioned above, a number of guidelines, or rules, were set up before the translation process was initiated. Apart from the effort made to ensure a certain level of consciousness amongst the participants

regarding the fundamental principles of terminology work, this included the formulation of a number of (linguistic) rules of syntax, morphology, and orthography to which everybody could refer and with which they were to comply. The message regarding general principles of terminology work was passed on to the participants at a seminar/workshop in the spring of 2005, and the linguistic guidelines, already established in connection with the pilot project in 2004, were reviewed and updated.

## Terminological principles

Depending on the task in question, certain generally accepted term requirements must be complied with in order to ensure terms of high quality. In the present project , interdisciplinary cooperation and reviews as well as the need to meet specific term requirements were particularly important. Term requirements at issue in medical LSP were thoroughly discussed in my PhD dissertation of 1998 (Høy 1998); for the SUNDTERM translation project, the following major requirements were adopted:

- **unambiguity** (a term having the status of "preferred term" must not refer to more than one concept in the hierarchy in question)
- **linguistic correctness** (national syntactic and orthographic rules must be complied with)
- **motivation** (immediately understandable terms, i.e. terms reflecting the characteristics of the underlying concept, should be preferred)
- **international recognizability** (terms based on Latin and Greek word elements should be preferred)
- **psychological acceptability** (clinicians' habits should be taken into account whenever possible)
- **systematism & consistency** (similar morphological and syntactical solutions should be sought for terms covering semantically similar concepts).

Unfortunately, these requirements will often be in conflict. Psychological acceptability tends to be an obstacle to compliance with several other principles:
Commonly used and accepted eponyms such as Apgar score or Down syndrome are at odds with the wish for motivation; the general clinical preference for Danish (or even English!) terms is in conflict with international recognizability or linguistic correctness; and random habits of using noun+noun and adjective+noun constructions respectively for terms challenge systematicity & consistency (such as "hjertelyd" = heart sound as opposed to "kardiel revaskularisering" = heart revascularization).

For these reasons, not all SNOMED terms translated can be expected to meet all term requirements. In fact, changing a term because it does not meet one requirement may result in inconsistency in respect of another requirement. Therefore, the Editorial Board has a difficult task trying to comply with the principle of making general as well as individual decisions which are justifiable not only from a terminological and linguistic, but also from a psychological and clinical point of view.

## Linguistic principles

Because of the inevitably normative nature of the Danish terminology, defining a set of linguistic guidelines, including syntactic, morphological, and orthographic rules, was also crucial. On a term status level, it was decided to give preference to so-called hybrids (i.e. terms based on Greek and Latin morphemes but adapted to Danish) which are widely used by clinicians, but to accept the use of purely Greek or Latin terms for certain diagnoses, and in particular for anatomical concepts; purely Danish and English terms are to be accepted only when an alternative choice would be incompatible with current clinical use. On a term corpus level, recommendations as defined by the Danish Language Council are generally followed, but a number of specific morphological and orthographic rules were specified for the construction of hybrids, since no rules pre-existed in this area and many different orthographic variants could be found in the medical literature.

In short, the guidelines laid down include directions regarding:

- the level of validity ascribed to already approved sources of information (national special dictionaries, textbooks, specific homepages, etc.)
- the extent to which foreign (mainly English) terms may be accepted as such
- the choice of term type – purely Latin/Greek terms, hybrids, or purely Danish terms
- morphological and orthographical principles for the formation of hybrids
- the handling of eponyms, abbreviations, formula, symbols, punctuation, etc.
- orthographical and syntactical solutions in cases in which several solutions may be correct
- problems originating in the multi- and poly-hierarchical, ontology-like structure of SNOMED CT©.

## Translation techniques

The translation of complex terms presented to the translator in an extra-textual setting requires a rather high level of domain insight on the part of the translator in order to ensure that any target language word or phrase chosen be an exact representation of the source language concept. On several occasions, the attention of the SUNDTERM project participants has been drawn to the necessity of considering the meaning of the term, i.e. of applying a concept based translation approach and, in case of any doubt, of consulting the hierarchical position and the semantic relations of the concept in question. Within a functionalist translation approach, various techniques may be applied as described by Molina et al (Molina et al. 2000). To some extent, techniques like borrowing or literal translation may be recommended as long as concept equivalence is ensured: the resulting target language terms are internationally recognizable and often psychologically acceptable to clinicians, and they make it possible to conform with the structure of SNOMED CT®. But several more genuinely functionalist techniques are very often used, for instance transposition, amplification/description, and established equivalents. To a large extent, the translation methodology and solutions resemble the ones in prominence in connection with the translation into Spanish of SNOMED CT® as described by Reynoso et al (Reynoso et al. 2000).

The main translation techniques applied are represented in the table below.

| **Translation technique** | **English term** | **Danish term** |
|---|---|---|
| borrowing | *cardiac output* | *cardiac output* |
| calque or literal translation | *closed fracture of metacarpal bone* | *lukket fraktur af metakarpalknogle* |
| transposition (change of grammatical category) | *disability affecting daily living* | *funktionsnedsættelse der påvirker daglig livsførelse* |
| amplification/ description | *battered wife* | *hustru der har været udsat for vold i hjemmet* |
| established equivalent | *product of conception* | *befrugtet æg* |

## Equivalence and false friends

As mentioned earlier, questions related to terminology structure rarely play an important role in translation as such, since most ontological and epistemological patterns are similar in the source and target language. The important criterion of successful communication, as pointed out by Reynoso et al (Renynoso et al. 2000) in their article about the translation of SNOMED CT® into Spanish, will be met: "the same symbol should evoke similar concepts in different people's minds". In most cases, it is possible – with the appropriate linguistic and professional insight – to find a target language term which would match the source language term. Thus, in principle the translation of the above mentioned Gram negative bacteria and Gram positive bacteria, phantom limb syndrome without pain, and possible thrombus should not be too problematic.

However, sometimes the epistemological issue is of a social or cultural nature, and in such cases, the translation becomes difficult because of the lack of concept equivalence: Some IS-A relations of SNOMED CT® represent an arbitrary or national (American) conception of the world which may not necessarily be acceptable on a worldwide scale. For example, the concept person in the healthcare environment, which is the top-level concept (parent concept) of an entire SNOMED CT® sub-hierarchy, encompasses a vast number of – American – job titles. Although it would normally be possible to obtain a reasonably

motivated Danish term for each concept, the IS-A relations between these concepts are not based on a truly ontological principle. From an epistemological perspective, the term-concept-entity relationship is not static, and the translated Danish term with its underlying concept may be completely useless because of socially or professionally based cultural differences.

Even concepts which are seemingly equivalent may not be so after all: the English term typhus and the Danish term tyfus are so-called "false friends"; the correct translations would be English typhus = Danish plettyfus and English typhoid fever = Danish tyfus. Similar problems arise when a term covers a broader concept in one language than in the other. This is the case with the English words substance and drug which are constituent parts of a number of terms: translating substance into substans in Danish would in some cases be OK, in others it would be nonsense. As for drug, a holonym with a broad semantic coverage in English, there is no similar word nor concept in Danish; the solution is to find the meronym in Danish which may best represent the concept in each individual case.

## Concluding remarks

Apart from their necessity to the electronic health record from a data modelling point of view, the IS-A and the semantic relations may sometimes be the only means of detecting the concept behind a given term. Therefore, they are extremely valuable sources of information to the translators, reviewers, and editors in the translation process. Very often, the translator's uncertainty originates in ontological or epistemological inconsistencies or in the lack of concept equivalence as a result of cultural differences. This does of course present a problem, but within the SUNDTERM project framework, the major concern is to provide a Danish term for each SNOMED CT® concept. The systematic or ontological improvements which must inevitably be made to the structure of the core version of SNOMED CT® will have to be applied to the national version later. Anyhow, any national version of SNOMED CT® will need to be adapted to local conditions: deletions, changes, and additions of concepts are inevitable. Therefore, all terms are currently translated notwithstanding the "would-never-be-used" status of the underlying concepts in a Danish setting.

## THE SUNDTERM TRANSLATION WORK FLOW

The work flow may be described as follows:

1. A so-called batch of SNOMED CT® concepts to be translated is selected by SST. Each batch forms a subset containing approximately 10,000 concepts which belong to a certain medical specialty. The translation bureau is granted a period of one month for translating a batch.

2. The translation bureau distributes the terms among 5-6 translators who have specialized in the translation of medical LSP.

3. After translation, the term is reviewed by another translator. At this stage, the term may be returned to the translator for further investigation or it may be accepted. The reviewer may also choose to consult a subject matter expert (SME). If no solution is found and/or the concept or the term present a particular problem, the reviewer may send it directly to the Editorial Board.
4. A term accepted by the reviewer of the translation bureau is taken over by a SST reviewer. These reviewers all have a medical or paramedical background and/or linguistic training. They may accept a term, in which case it is "approved", or they may return it to the translation bureau if they deem it incorrect or not compliant with the linguistic/terminological guidelines, or they may pass it on to the Editorial Board for further verification or investigation.

5. The Editorial Board may either accept the term, find a solution, or return it to the translation bureau – in case it is evident that the term does not cover the meaning of the concept or if the guidelines or work flow have not been complied with.

Fig. 1 below shows the work flow chart; the minimum cycle for any term is shown by means of bold-faced arrows:

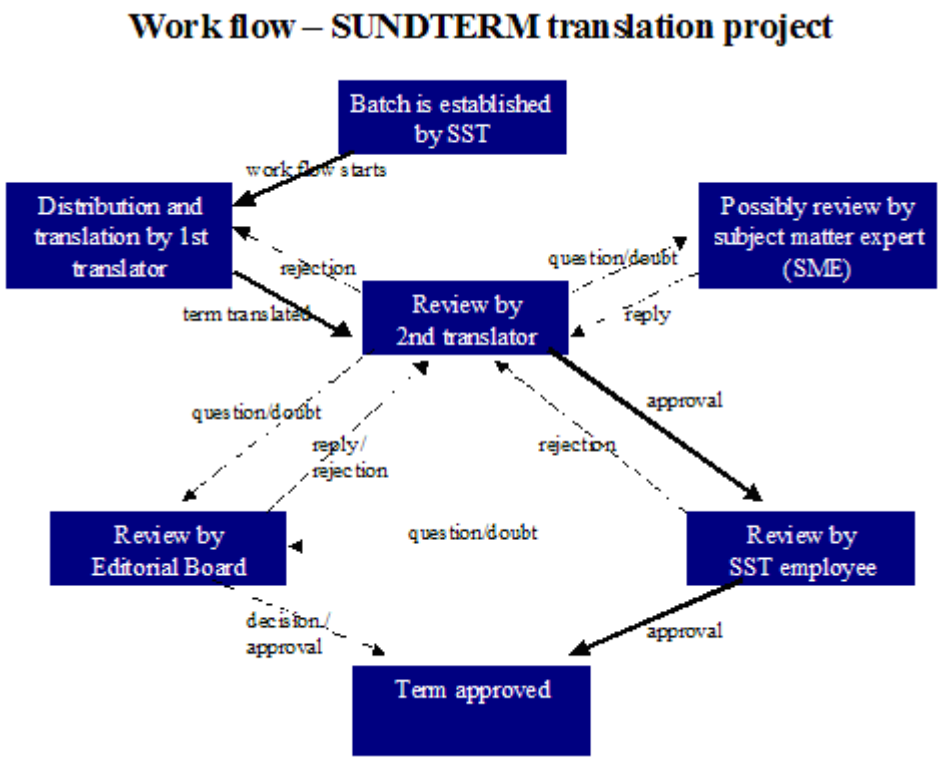


Fig. 1

Fig. 2 shows an example of the user interface in the case of a concept having worked its way through the work flow:

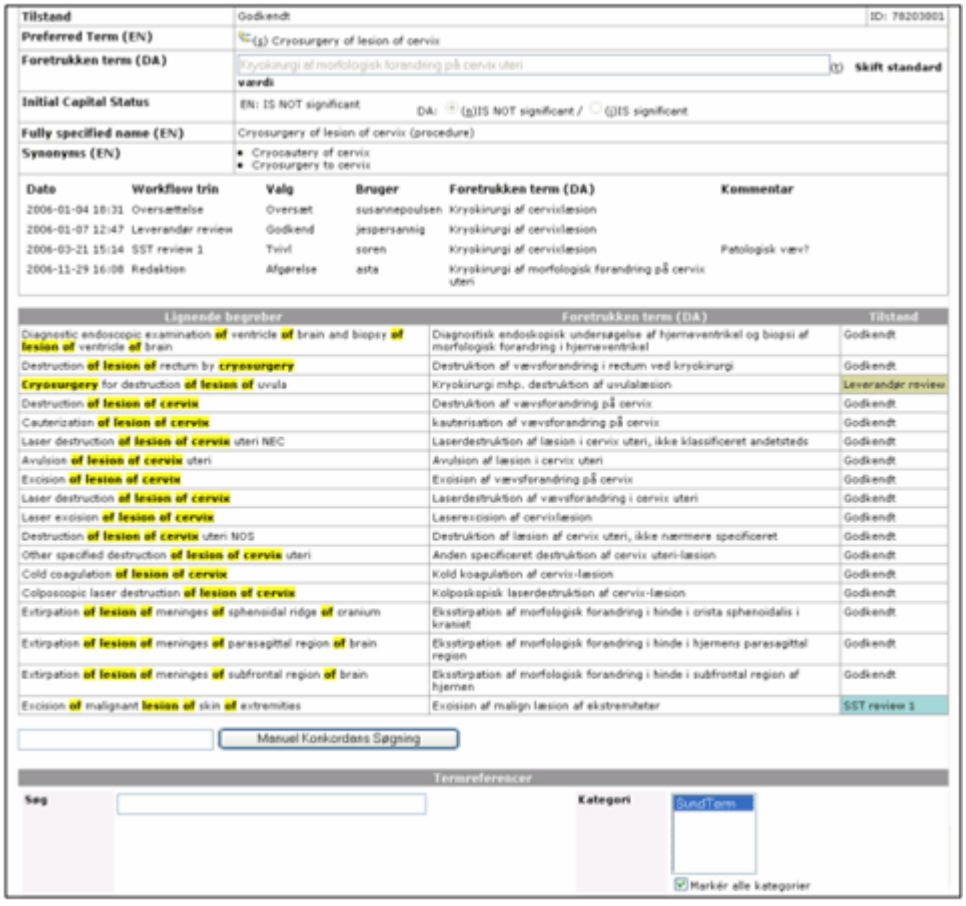

Fig.2

The original translation of this term was approved by the local reviewer and sent on to the SST. The SST reviewer made a comment on the compound ”cervixlæsion” and sent the term on to the Editorial Board. This led to a discussion of principles regarding the translation of lesion in the sense of tissue alterations not resulting from injuries, and the term was finally changed and approved. At the same time, guidelines regarding the translation of the English term lesion were registered in a document of decisions of principle of the Editorial Board. This document is accessible to all those who have access to the application.

## CONCLUSION

Translating SNOMED CT® into another language than English is a time consuming, resource consuming, and complex task which demands close collaboration between skilled specialists within medicine, linguistics, terminology, information technology, and project management. Preparatory work, introducing all participants to the basic structure of SNOMED CT®, elaboration of efficient and transparent tools, definition of roles and work flow, as well as specific terminological and linguistic recommendations and rules, are important quality criteria.

In spite of all the efforts, it cannot be expected for a national version of SNOMED CT® to become a totally consistent terminology. On the one hand, inherent ontological inconsistencies in SNOMED CT® will inevitably be transferred, and on the other hand, national habits, needs, and wishes in regard to a medical terminology and its use make it necessary to reach compromises on the terminological-linguistic level.

With the SNOMED Standards Development Organisation (SDO) which is being founded now in late 2006, it may be expected that considerable structural improvements will be made to the terminology over the coming years. Yet many of the issues described and discussed in the present article will remain questions and challenges which have to be overcome in a translation context. Hopefully, the experience derived from the Danish translation project, still in progress, may be of help to those who consider translating the terminology into their own national language.

[1] Most term examples in this article have been gleaned from the July 2005 version of SNOMED CT®, so that some of them may not occur in the present version.

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